Models of best practice in flood risk communication and management

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Abstract: Risk communication plays an increasingly central role in flood risk management, but there is a variety of conflicting advice about what does—and should-- get transmitted, why, how, and to whom. The aim of this paper is to elucidate the underlying normative and conceptual models on which those competing assessments of 'good' risk communication depend. To that end, the paper identifies four broad models, or approaches, to risk communication: a risk message model of information transfer; a risk instrument model of behavioural change; a risk dialogue model of participatory deliberation; and a risk government model of self-regulation and normalization. These models differ in their theoretical and disciplinary origins and associated philosophical and political commitments, and consequently they define the basic purpose, practice, and future prospects of flood risk communication in quite different ways. Unless these different models of 'good' risk communication are acknowledged and understood, efforts to identify best practice for flood risk management are likely to produce inconsistent, if not contradictory, recommendations.

1. Introduction

The EU Floods Directive (2007/60/EC) puts risk maps and associated forms of risk communication at the centre of a common European "framework for the assessment and management of flood risks" (article 1). At its most basic, risk communication can be defined as "the flow of information and risk evaluations back and forth between academic experts, regulatory practitioners, interest groups, and the general public" (Leiss, 1996, p. 86), and it is an increasingly prominent feature of regulation and of corporate governance strategies across a wide range of domains.

In the case of flooding, risk communication plays a pivotal role in a wider paradigm shift from engineering-based flood defence to more integrated risk-based management, and there has been an explosion of research assessing its effects on risk perceptions, behavioural responses, and institutional management. While a number of recent reviews have attempted to distil best practice guidance from this rapidly growing literature (Kellens et al., 2013; Löfstedt and 6, 2008; Parker et al., 2009; Van Alphen et al., 2009; Wachinger et al., 2013), it is important to recognize that the very idea and purposes of risk communication are contested and thus that what counts as 'good' risk communication depends very much on the standpoint from which it is judged. Unless these different models of 'good' risk

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communication are acknowledged and understood, the result is likely to be inconsistent, if not contradictory recommendations.

The aim of this paper is clarify the various underlying theoretical models on which assessments of 'best' practice in flood risk communication are based. To that end, we begin by describing a number of different approaches to making sense of the wider field of risk communication before introducing the four-fold classification scheme we use to organize our discussion of recent research and best practice recommendations for flood risk communication. Then in the sections that follow we consider each model in turn seeking to highlight how their different framings of the basic purposes and practice of risk communication then shape their assessment of its effectiveness and of the major research challenges to be addressed in order to improve flood risk communication. The paper then concludes with some broader reflections on the ideal of best practice and the ways in which it can serve to conceal the politics and power relations involved in risk communication.

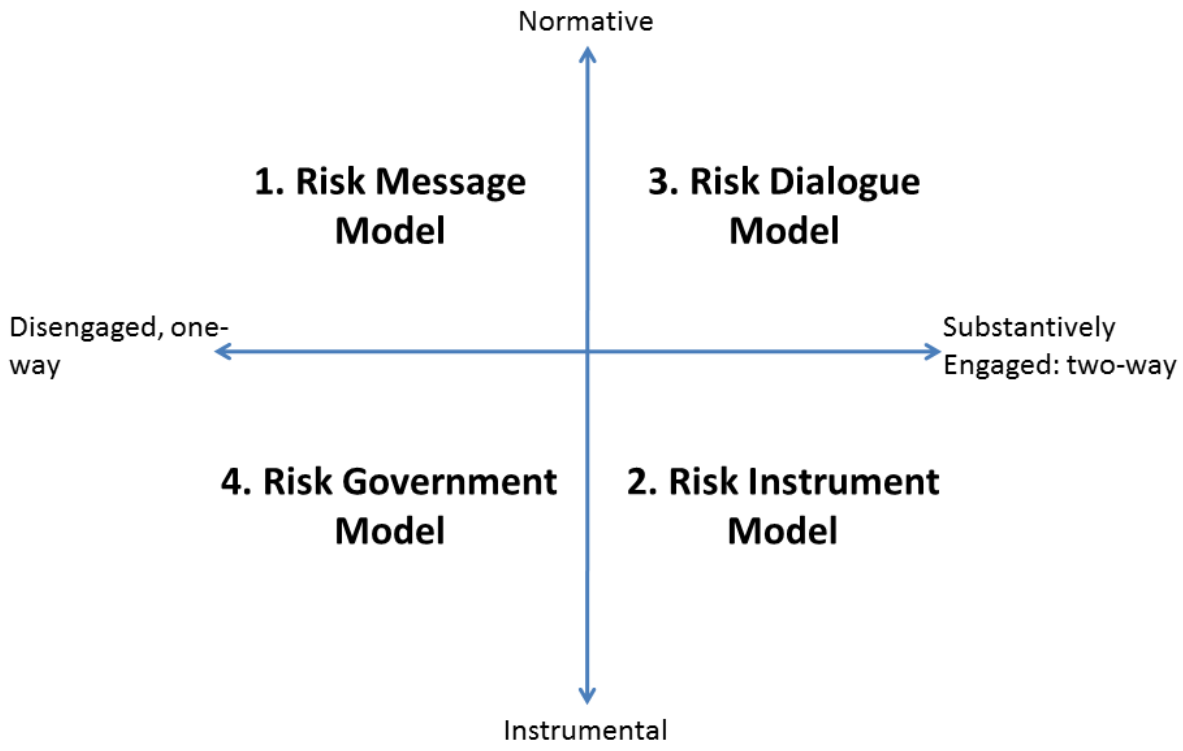
2. Modelling risk communication

Risk communication is a comparatively new and multidisciplinary field of practice, and there is a variety of ways to make sense of the various conceptual paradigms and disciplinary approaches it involves. One way of parsing the field is historical. Thus, Leiss (1996) has described three phases of risk communication involving successively greater engagement and dialogue, while Fischhoff (1995) provocatively narrated seven developmental phases from the initial idea that 'all we have to do is get the numbers right' to the idea that 'all we have to do is make them partners'. But whether it is three phases or seven, such historical narratives tend to imply the successive displacement of one paradigm by another rather than the steady accretion of competing understandings of the purpose and practice of risk communication.

In place of chronology, other typologies parse the literature in terms of the underlying rationales for risk communication (Fiorino, 1990). Normative rationales see communication as simply the 'right' thing to do, though the reasons *why* it is seen as right are contested, and this has important implications for what 'good' risk communication is said to involve. Some normative rationales invoke the fundamental democratic right for citizens to be informed, but risk communication is also central to various other institutional imperatives in a democratic society. For example, the 'honest broker' role of science advisors in policy-making relies on risk communication to bridge functional and institutional divides between the science of risk assessment and the politics of risk management (Pielke, 2007). In turn transparent communication about the basis on which policy decisions are made then helps ensure their fairness, impartiality, and public acceptance (Porter, 1995). These normative rationales imply that risk communication is a one-way process of information transfer from experts to policy-makers and lay publics. By contrast other normative rationales for risk communication look to deliberative ideals about citizen participation (Buchecker et al., 2013; Tsouvalis and Waterton, 2012). They imply that risk communication should be a two-way dialogue involving the communication of values as much as scientific facts. Instrumental rationales, by contrast, see risk communication as a way to influence the attitudes and behaviour of others in ways desired by those sending the message. Substantive rationales for risk communication emphasize its potential to improve the quality of risk assessment, the processes of risk management, and/or the outcomes that result for all those involved. Though clear in the abstract,

these rationales for risk communication often bleed into each other in actual practice. Moreover, the goals of risk communication do not necessarily dictate the means or provide much guidance about how best to achieve them.

Figure 1. Four conceptual models of risk communication. After Wardman (2008)



Wardman (2008) has tried to provide greater conceptual clarity by framing risk communication along two orthogonal dimensions (Figure 1). His vertical axis distinguishes risk communication by its underlying rationale, whereas his horizontal axis distinguishes between engaged and interactive, often two-way, forms of communication at one extreme and less engaged, one-way styles at the other. The result is four ideal-typical models of risk communication, each grounded in different theoretical traditions that suggest different ways of defining 'good' risk communication and evaluating its effectiveness.

In the discussion that follows, we use Wardman's four ideal-types to distil the basic ideals animating flood risk communication and shaping the search for best practice.

3. The risk message model

Technical risk assessments are worthless if they do not reach the decision-makers they are meant to inform. The risk message (RM) model proceeds from the belief that 'good' risk communication is about

faithfully transmitting risk information without distortion, bias or misunderstanding. Behind this deceptively simple understanding of risk communication as information transfer lie a number of contentious normative, epistemic, and political assumptions. Normatively there is a broadly liberal understanding of the democratic imperatives for citizens to be informed and for governments to be transparent about risk and its management. Epistemologically, this approach to risk communication is often associated with a deficit model of public (mis)understanding in which experts are assumed to possess superior scientific knowledge of risk and to rely on risk communication to disseminate it to the ignorant. As this implies, the RM model is also predicated on a series of institutional distinctions between the science of risk assessment and the politics of risk management, between experts and lay publics, and between policy-makers and the citizens on whose behalf they are acting. These divides are then bridged by largely one-way flows of risk information.

The intellectual roots of the RM model lie in information theory and the encoder-decoder model of signal transmission. As first articulated by Shannon and Weaver (1949), communication involves three steps:

1. a sender **encoding** a risk message;
2. **transmission** of that signal over a channel to a receiver;
3. the receiver successfully **decoding** the risk message from background noise.

In their original formulation meaning is understood to be a self-contained property of the message itself, rather than as something that is actively generated in and through the inter-textual and inter-subjective practices of producing, transmitting, and interpreting the message, as more recent work in cultural and media studies has tended to emphasize (Hall, 1997).

Accordingly one important focus for research in the RM tradition has been on identifying the design features most conducive to successful communication of flood risk information. For instance, the shift from deterministic to probabilistic forecasting raises important questions about how best to communicate the vast increases in information richness produced by these new technologies (Demeritt et al., 2010). Several recent studies have tried to test visualization methods for communicating probabilistic flood forecasts (Bruen et al., 2010; Pappenberger et al., 2013; Stephens et al., 2012), while the European Commission sponsored an Exchange Circle In Flood Forecasting (EXCIFF) to develop and disseminate best practice recommendations (Martini, F. and De Roo, 2007). However, as Speigelhalter et al (2011, pp. 1399–1400) note there is a dearth of large and sophisticated randomized trials necessary to "assess preferences and understanding of appropriate choices of formats for different audiences," and so a result operational services across Europe have often struggled to decide whether and how to communicate forecast uncertainty (Demeritt and Nobert, 2011; Demeritt, 2012; Demeritt et al., 2013).

Communicating uncertainty is also a challenge in flood risk mapping. While there is no shortage of best practice recommendations about map design and dissemination (Bostrom et al., 2008; EXCIMAP, 2007), they are based largely on surveys of experts (Kunz et al., 2011; Meyer et al., 2012; Van Alphen et al., 2009), rather than systematic trials to test the effectiveness of alternative cartographic designs for delivering flood risk messages to the public, who have often been shown to underestimate their exposure and to ignore risk maps and other information sources (Burningham et al., 2008; Harvatt et al., 2011). Those evaluations that have been conducted tend to involve relatively small samples and to

offer somewhat contradictory recommendations, with Fuchs et al (2009) highlighting the importance of map layout and symbology, but other studies recommending dynamic displays involving 3D representation and flash animations (Bass and Denise Blanchard, 2011; Zaalberg and Midden, 2013).

More systematic evaluation is needed because the RM model highlights the potential for breakdowns at the transmission and decoding phases. For instance, most flood risk maps are based on the idea of return periods, but several studies have found widespread confusion about the meaning of the 100 year flood (Bell and Tobin, 2007; Highfield et al., 2013), which the EU flood directive has made the default standard for flood maps across Europe, as it already is in the US through the National Flood Insurance Program. To overcome these cognitive failings in decoding its meaning, the US National Academy of Sciences (NRC, 2000) recommended supplementing the 100 year flood concept with other statistically equivalent measures of risk, such as the 1% chance flood or a flood with a 26% chance of occurring during a 30 year mortgage. By contrast Steinführer *et al*. (2009: 40) argue that the ability of the public to successfully decode such information is so limited that they recommend authorities "Do not use statistical probabilities in flood risk communication at all". The EU's *Handbook of Good Practices for Flood Mapping in Europe* acknowledges the issue, but avoids taking a stand one way or the other:

> As a basic principle, no more information than necessary for understanding should be presented to avoid misunderstandings or produce something that is counterproductive to public flood risk awareness (EXCIMAP, 2007, pp. 42–43).

While there has been extensive research about the relative merits for communicating medical risks of relative versus absolute risk measures and of natural frequencies as against statistical probabilities (Spiegelhalter et al., 2011; Visschers et al., 2009), these questions are much less researched for hydrometeorological hazards. Several experimental studies with students have found that providing probabilistic forecast information improves decision-making (Joslyn and Nichols, 2009; Roulston and Kaplan, 2009), though there is also evidence about the importance of message framing and formatting to how forecast uncertainty is interpreted (Joslyn et al., 2009). By contrast survey research has found widespread public misunderstanding of the meaning of probability of precipitation forecasts (Gigerenzer et al., 2005), though whether the failure to grasp their precise technical meaning impedes decision-making is contested (Morss et al., 2010). Nevertheless, to prevent misinterpretation, several studies recommend that forecasters take greater care to specify the reference class to which their probabilistic forecast refers (Gigerenzer et al., 2005; Handmer and Proudley, 2007; Stephens et al., 2012).

4. The risk instrument model

Whereas the RM model measures success simply in terms of information transfer, often on the implicit assumption that overcoming information deficits will, by itself, be sufficient to achieve disaster risk reduction, the Risk Instrument (RI) model is more explicit in seeing risk communication as a conscious instrument for changing the attitudes and behaviour of message recipients. Understood as "any *purposeful* exchange of information about risks between interested parties" (Lang et al., 2001, p. 317), 'good' risk communication in the RI tradition thus depends on those interests and their purposes. For example, one reason to issue severe weather warnings is to protect public safety, and so, from a RI perspective the success of a storm warning depends on it leading to an appropriately precautionary response. Of course defining 'appropriate' here is a matter of perspective—and power—and the RI

model is not shy about making such value-laden and politically charged judgments, unlike the RM model whose liberal ethic of informing without distortion provides no way to distinguish between hurricane warnings that prompt beach front residents to schedule storm parties to watch the high seas roll in and those that lead residents to evacuate. Thus, the RI tradition recognizes communication as a strategic exercise of power designed to further the interests of some groups by influencing the attitudes and behaviors of others.

In addition to this difference in its normative orientation, the RI Model also pays much closer attention to the interactions between information, attitudes, and behaviour. With its focus on the encoding and transmission of risk messages and on cognitive biases in their interpretation, the RM model tends either to ignore behaviour altogether, on the principle that good risk communication should inform, not influence, the decisions made by autonomous consumers and policy-makers, or to theorize behavioural responses in terms of a rational actor paradigm of calculation and utility maximization based on idealized cost-loss functions (e.g. Buizza, 2008). By contrast the RI model taps into a social psychological literature on the processes shaping risk perception and response (e.g. Bubeck et al., 2012; Harries, 2012; Kahan et al., 2011), even as it shares with the RM model an understanding of risk communication as essentially one-way and linear.

In the specific context of flood risk communication and management, the RI model focuses research on identifying the factors that might explain why people living in flood prone areas often downplay their risk and fail to respond to awareness raising campaigns by taking the recommended steps to reduce their risk of death, injury or property damage (Bubeck et al., 2012; Burningham et al., 2008; Harvatt et al., 2011; Soane et al., 2010). As with short-term warnings and evacuation orders (Parker et al., 2009), social class and education are strongly correlated with higher levels of awareness of flood risk and knowledge of how best to respond to it (Bubeck et al., 2012). Prior personal experience of being flooded is also often claimed to increase the perceived salience of and responses to risk communication messages (Burningham et al., 2008; Harvatt et al., 2011; Kellens et al., 2011), though this is contested by Soane et al. (2010), and different explanations of why prior experience of flooding motivates preparedness action lead to different best practice recommendations about how to change public risk perception and response through risk communication. Wagner (2007) attributed the higher levels of preparedness for flash floods as against landslides to their greater frequency and consequently to better developed mental models of their causes among residents of the Bavarian Alps. This suggests that the best way to change behaviour would be to concentrate on communicating hazard information about the probability of harm. By contrast, Siegrist and Gutscher (2008) found that it was better awareness of the potential *consequences* of flooding that explained the greater responsiveness to flood risk information among those with first-hand experience of being flooded as against those living in flood-prone areas but without any personal experience of being flooded. Accordingly they recommend that risk communication must not focus solely on technical aspects, but "must also help people to envisage the negative emotional consequences of natural disasters" (p.777). Drawing on this affect heuristic (Slovic et al., 2007), a number of scholars recommend that risk communication should tap into the negative emotions associated with being flooded so as to motivate preparedness adaptations (O'Sullivan et al., 2012; Terpstra, 2011; Wachinger et al., 2013).

However, Harries (2012) recommends caution about flood risk communication strategies designed to increase fear in hopes thereby of motivating a precautionary response. Noting that people prefer to think of their homes as places that are intrinsically safe, he suggests that risk messages that threaten the ontological security associated with the home may prompt responses of denial, which is one reason for the low take-up of apparently 'rational' household resiliency measures, like flood gates. Kahan et al. (2011) have highlighted a similar process of motivated reasoning in the case of climate change, whereby information congenial to prior beliefs about its (un)reality is differentially sought and credited.

In this way social psychological research on the role of emotion in processing and responding to flood risk information intersects with sociological work highlighting the importance of trust in shaping responses to flood risk communication. Survey research in several EU member states (Grothmann and Reusswig, 2006; Terpstra, 2011) has found that higher levels of trust in government are associated with lower levels of preparedness and perceived flood risk, though two qualitative case studies in England found distrust in the agencies responsible for flood risk management to be associated instead with feelings of powerlessness and fatalism (Burningham et al. 2007; Harvatt et 2011). The issue of trust is closely wrapped up with constructions of responsibility and blame (Bickerstaff et al., 2008; Escobar and Demeritt, 2012). In the Netherlands, government plans to create 'calamity polders', which would be intentionally flooded in the event of catastrophic flooding to protect more densely populated areas, were skuppered by local opposition fuelled by distrust of the top-down, technocratic process by which the proposals were formulated (Roth and Warner, 2007). Faced with such opposition, one lesson being drawn is about the importance of engaging in dialogue with those directly affected by flood policies. Indeed article 9 of the EU Floods Directive (2007/60/EC) now requires member states to encourage the "active involvement of all interested parties" in the production of flood risk maps and management plans-- but as we discuss in the next section, the purpose and practice of such participatory forms of risk communication can be understood in some rather different ways.

5. The risk dialogue model

As its name implies the Risk Dialogue (RD) model is based upon two-way exchanges that blur the sharp distinction between senders and recipients implied by the RM and RI models. Calls for RD are underpinned by a variety of normative and metaphysical commitments. For many academic theorists, public participation fulfils a fundamental democratic imperative (e.g. Fiorino, 1990), but normative rationales for the RD model are often invoked alongside more instrumental and substantive ones. Thus the best practice guidance on flood prevention, protection, and mitigation from the EU Water Directors intones:

> Public participation in decision-making concerning flood prevention and protection is therefore needed, both to improve the quality and the implementation of the decisions, and to give the public the opportunity to express its concerns and to enable authorities to take due account of such concerns (EU Water Directors, 2003, p. 13).

This kind of policy recommendation fails to acknowledge fully the tensions among competing normative, instrumental, and substantive rationales for RD. These different commitments, in turn, lead to different

recommendations about who should participate and why and indeed about what the dialogue should be about. For example, dialogue with the substantive aim of tapping into local knowledge to improve the quality of flood risk assessments should be restricted to participants having that knowledge and should avoid discussing other issues that would become pertinent if the aim were to win local support for a coastal realignment scheme, where dialogue might be targeted at affected landowners, or to deliberate on local tax funding for a flood defence scheme where democratic norms would require that participation be open to all citizens who would be affected by the levy. But despite intense debate about which people should be included and how they should deliberate, the literature on RD remains tethered to a humanist conception of politics in which humans are the only active subjects and the rest of creation is rendered as mute and objective matter to be talked about but never with (Demeritt and Dyer, 2002). These assumptions about politics are being challenged by some new strands of political theory that "extend the terms of a more fully materialist politics attuned to the 'force of things' … through the convergent registers of affectivity, assemblage, and event" (Braun and Whatmore, 2010, p. xxiv). This materialist political theory suggest the potential for a much broader RD that would acknowledge the 'more-than-human agency' of nonhumans and seek to incorporate them within some kind of extra-human 'parliament of things' (Bennett, 2005; Latour, 2004).

In the case of flood risk management, RD has been designed in different ways to serve different ends and producing different effects. This variety, combined with the reliance on individual ex post case studies rather than the systematic evaluation methods recommended in the wider literature on RD (Buchecker et al., 2013), makes it difficult to provide evidence-based general assessments. A number of case studies from across the EU have documented how RD can help refine flooding policy proposals to better meet stakeholder needs as well as securing higher levels of compliance with their strictures than might otherwise have been the case (e.g. Buchecker et al., 2010; Fleischhauer et al., 2012; Howgate and Kenyon, 2009; Lane et al., 2011; Posthumus et al., 2008). Likewise several studies have suggested that engaging users in the design of forecasting and early warning systems can improve the effectiveness of the resulting warnings, but whereas some recommend that forecasters focus their engagement on professional partners (Alexander et al., 2013; Nobert et al., 2010), others highlight the importance of engaging with the general public (Parker et al., 2009). "Feedback and two way communication" from both groups is recommended as "essential" by the EXCIFF good practice guide on flood forecasting to "ensure the information fits" and "avoid misinterpretation" (p.50), though alongside this substantive rationale for RD, there are also hints of instrumentalism in the suggestions elsewhere about how "to be successful in persuading and influencing behavioural change (p.46)" (Martini, F. and De Roo, 2007).

Similarly varied hopes have been invested in the potential of RD for flood risk mapping. In the development context, participatory mapping has long been used in disaster risk reduction as a tool for both information gathering and local empowerment (Cadag and Gaillard, 2012; Tran et al., 2009), and there are increasing calls to apply the same techniques for flood risk management in developed countries (Sultana et al., 2008). Participatory methods have been successfully used to address the paucity of flood inundation extent data for model calibration and validation (Connell et al., 1998; Parkes et al., 2013; Parkin, 2010), and there are also efforts to mobilize flood memories to enhance local resiliency planning (McEwen and Jones, 2012). But if the aim of RD is to crowd-source new facts, then it follows that participation should be restricted to those with appropriate information to deliver, whereas

if the purpose is build trust or secure the democratic warrant and legitimacy of risk mapping then RD must be organized in some different ways to serve those different purposes, which require dialogue with different groups about different things. Unfortunately these differences are not always recognized in the very generalized best practice recommendations for more public participation in flood risk mapping (EXCIMAP, 2007; Meyer et al., 2012).

Research has identified a number of practical and political barriers to realizing the high ideals of RD. Shortages of time, expertise, and enthusiasm can impede meaningful participation by the public in participatory mapping exercises (White et al., 2010), while for their part institutions sometimes struggle to open themselves up to participation that might challenge established norms and practices (Cook et al., 2013; Videira et al., 2006). A study of flood risk management in Hungary found that civil society groups had not filled the gap left by the post-communist retreat of the socialist state, leaving flood managers without an active public to engage with, while Hungary's highly legalistic framework for civil protection left little scope to respond flexibly to local demands and reinforced the ingrained bureaucratic tendency to secrecy for fear of having failures exposed and losing public confidence (Vari, 2002). By contrast, in England, flood managers at the Environment Agency are much more accepting of the idea of public engagement albeit to sometimes rather instrumental ends. This instrumental framing of RD is reflected in the very title of the 'Building Trust with Communities toolkit' used by the Agency to engage with communities in hopes of getting them "to accept a certain level of flood risk, to accept that they need to share some of the responsibility, and to accept that by designing spaces to flood safely ecological benefits will also be increased" (Speller and Twigger-Ross, 2005, p. 4).

A number of participatory modelling experiments come closer to deliberative democratic ideals of RD. One of collaborative project in England involved social scientists, hydrologists and local residents co-producing not just a new model of flooding in the area but also a new framing of the problem, which in turn pointed to some new solutions to that reframed problem (Lane et al., 2011). Seen from the perspective of a new materialist political theory, the participants in this RD can even be said to have included the materiality of the flood event and the embodied processes of engaging with it, which are "implicated in the creation of different forms of collectivity" ((Donaldson et al., 2013, p. 616). More typically lay participation does not extend quite so far 'upstream' into model design itself but is instead restricted either to assessing the plausibility of its predictions (Ritzema et al., 2010) or interacting with the model to inform deliberative processes to identify policy options and select among them (Stefanska et al., 2011). Several scholars applaud RD for precisely this potential to encourage greater reflexivity among researchers and to aid in reframing problem formulations (Demeritt, 2009; Henwood et al., 2008). Others are more circumspect, however, highlighting limited lay capacities to contribute substantively to model specification and validation (Millington et al., 2011) and the risks from overhyping the emancipatory potential of RD (Johnson, 2008; Tsouvalis and Waterton, 2012).

6. The risk government model

Like the RI model, the Risk Government (RG) model sees risk communication as an exercise of political power, but it theorizes power and its operation in some very different ways. The RI model sees risk communication as a instrument for bending others to the will of the risk communicator, sometimes

without much reflexivity about the coercion involved in "'A' getting 'B' to do what 'A' wants" (Dahl, 1957) . In contrast to Dahl's classic definition of power, the RG model draws heavily on Foucaultian ideas of 'governmentality' (Dean, 1999; Foucault, 1991; Rose et al., 2006). It theorises power in less instrumental terms as productive, rather than repressive, and as acting diffusely on the social to inculcate new attitudes and behaviours, often through logics of individual choice and self-discipline, rather than explaining new norms of conduct as being imposed from above through coercion. From this governmentality perspective, the focus on participation promoted by the RD model might be understood as a way of constituting individuals as self-regulating "environmental subjects … for whom the environment constitutes a critical domain of thought and action" (Agrawal, 2005, p. 17). This kind of Foucaultian subjectification operates not by constraining participants' freedom of choice or forcibly repressing particular forms of conduct, but instead by positively inviting them to participate and so actively enrolling themselves in new ways of thinking, being, and behaving.

The RG perspective understands risk as central to the organization and governance of late modern society (O'Malley, 2008). Whereas the sociologist Ulrich Beck (1992) famously theorized that incalculable threats like climate change are triggering a new phase of more reflexive modernization concerned with the risks created by modernity itself, the RG perspective approaches risk less as an external bad to be managed than as a practical way of doing so. Transformed into a calculable risk, the uncertain prospects of future flooding become manageable through an open horizon of conscious choices among various possible precautionary, pre-emptive, and preparedness actions (Anderson, 2010).

The RG model thus sees risk communication as integral to risk management. Indeed, particularly in the context of public health, communication often constitutes the primary strategy for managing risk. Providing people with information about the effects of smoking or diet on their individual life chances enables them to make informed choices about leading healthier lifestyles (Löfstedt and 6, 2008). By mobilizing risk perceptions of individuals in this way, risk communication becomes a strategy for managing risk at a distance and for transferring responsibility for its management onto individuals. There are important connections here to Thaler and Sunstein's (2009) 'libertarian paternalism', which calls for governments to disavow 'command-and-control' type regulation and instead rely on information and incentives to 'nudge' individual behaviour in socially desirable ways whilst still respecting, indeed positively acting through, their individual autonomy and freedom of choice. Risk communication can serve other governance purposes as well. Risk can also be used to deflect blame for potential adverse outcomes by reframing them as acceptable risks that institutions could not reasonably be expected to prevent (Huber and Rothstein, 2013).

The difference between the RI and RG models is thus partly one of intellectual genealogy—the RI drawing from empirical social psychology and sociology, whereas the RG takes inspiration from governmentality theory-- but it is also one of analytical purpose. Research in the RI model focuses on measuring whether and how risk communication shifts attitudes and behaviour, often with the aim of providing advice about how to do so more effectively. By contrast, work in the RG tradition has sought to develop an academic vocabulary to describe the very logic of trying to govern through risk and risk communication, without much concern for real-world application.

Several scholars have drawn on RG ideas to explain the paradigm shift in flood management from engineering defences to more risk-based approaches to dealing with flooding as a risk that must be lived with and managed. Risk communication plays a central role in this shift by raising awareness of flood risk and encouraging people to assume more responsibility for managing it themselves, rather than looking to the provident state for protection. Indeed, it is those perceptions and the associated forms of conduct they inform, rather than the floodwaters themselves, that new flood risk management policies take as their central object. While some scholars emphasize the role of risk communication as a mechanism for responsibilizing the general public and shifting management responsibility away from the state (Butler and Pidgeon, 2011; Johnson and Priest, 2008), others theorize risk communication, and flood maps in particular, as technologies for organizing governance and ensuring inter-institutional coordination (Kuhlicke and Demeritt, 2014). Risk maps are used not merely to inform spatial planning decisions, but increasingly as tools for regulating them as well (Porter and Demeritt, 2012). However, research suggests that their effectiveness as steering mechanisms is often limited (Neuvel and van den Brink, 2009; Pardoe et al., 2011). In England the Environment Agency also uses risk to organize its own internal investment and emergency planning decisions, whereas in Germany Krieger (2013) found significant normative and institutional obstacles to such risk-based prioritization, which was resisted as discriminatory and undermining the duty of the state to provide security and of professionals to provide certainty. Similarly, concerns about the public-private divide in flood risk management were a consistent concern in a comparison of management strategies in the coastal cities of Rotterdam, Helsinki, and Hamburg (Mees et al., 2013).

The shifts in the logics of government highlighted by the RG model raise important questions of legitimacy and legitimation. Although some research in the RG tradition offers normative critiques of risk communication programmes (Shove, 2010), more typically, the aim is merely academic explanation rather than practical application or the generation of best practice guidance.

7. Conclusion

The field of risk communication has expanded rapidly and along with it so too has the volume of research and best practice guidance about flood risk communication and management. To impose some order on this proliferation of often conflicting analysis and advice, this paper has outlined four distinct models, or approaches, to risk communication. These models involve different normative and methodological commitments and lead to divergent best practice recommendations stemming from their heterogeneous theoretical and disciplinary wellsprings, which offer differing accounts of the character, quality, purpose, and practice of risk communication. With its liberal ethic of information transmission, the RM model emphasizes message design to improve clarity, whereas the RI model suggests tailored risk communication strategies are needed in order to nudge the risk perceptions and behavioural responses of recipients in ways desired by risk communicators. Both tend to favour one-way modes of communication, antithetical to the sorts of two-way communication advocated by the RD model. For its part the RG model is less practical and applied in its aims and more focused on academic analysis of how risk communication figures in the governing logics of late modernity.

As Wardman cautions risk communicators "draw from a wide body of techniques without necessarily being aware that the techniques they adopt bear the imprints of broader scientific, political, economic, or social theory [and]... are permeated by power/knowledge relations" (Wardman, 2008, p. 1621). Failure to acknowledge these different ways of defining the basic meaning and practice of risk communication can lead to inconsistent or contradictory recommendations about what it should involve. For instance, calls for two-way forms of risk communication are increasingly common, but as we have shown they can involve a number of quite different rationales, underpinned by different normative and metaphysical understandings of dialogue and the matters of concern it should address. If the aim is to ensure the democratic legitimacy for some risk management policy, this will require a different kind of risk communication strategy, involving different participants, channels, and exchanges, than one whose aim is merely to collect new facts from one group to inform the risk assessment being undertaken by somebody else.

In all of this, there is an important role for risk communication research to help risk communicators devise the most appropriate means for meeting their particular ends. Different ends will require different means, and so the idea that there is some singular body of best practice is a myth. Flood risk communication is necessarily political in ways that the myth of best practice not only fails to acknowledge, but can actively serve to conceal. Indeed the search for best practice is precisely about turning risk communication into a set of politically neutral tools and techniques, ready to be picked off the shelf without regard for the particular purposes and places to which they are being applied. It is under this pretence of providing strictly technical advice that the European Commission has issued various best practice handbooks on the communication of flood risk in maps and short-term forecasts (EXCIMAP, 2007; Martini, F. and De Roo, 2007). But harmonizing the provision of risk information according to EU-wide standards of best practice is a political project in itself own right, as the protracted conflicts over Europeanization should make abundantly clear (Demeritt and Nobert, 2011).

The point, however, is more general. Flood risk communication is a political practice, and seemingly technical questions about how best to design and implement flood risk communication strategies cannot be divorced from more obviously contestable and value-laden questions about the reasons for doing so and the relations of power reinforced as a result. These politics must be understood and acknowledged by practitioners, not simply because of their moral and professional responsibilities for the wider ends they are serving through risk communication, but also because, as we have shown in this paper, the very techniques of risk communication can involve tacit political commitments about the framing of risk and responsibility for its management. These assumptions are built into the different models of 'good' risk communication we have described, and consequently it is impossible to assess the effectiveness of risk communication without also making normative judgments about the effects it is creating.

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